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GAS IN INDUSTRY

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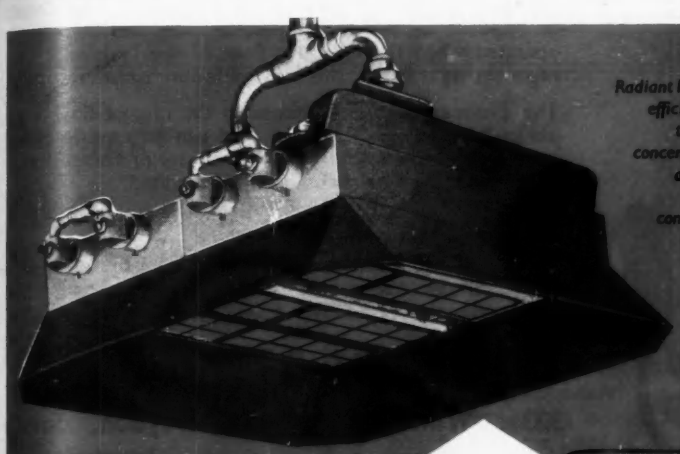

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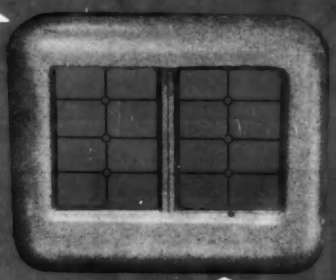

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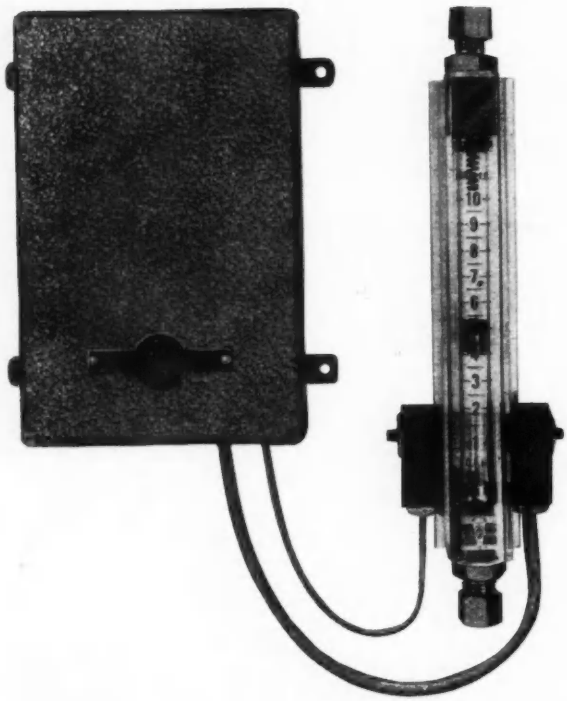

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GAS IN INDUSTRY

FEBRUARY 1961

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FEATURES

GAS ON THE RIGHT LINES

By A. Riley

MORE GAS-FIRED EQUIPMENT FOR STOVING

CAR COMPONENT MAKERS FIND GAS IS IDEAL FOR HEAT TREATMENT

By Eric Ford

LOOKING AROUND — Industrial Gas Development Committee reports.

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Editorial

Gas helps to build locos

THE railways in Great Britain have always been gas-minded and their unfavourable attitude to the use of electric lighting on their stations up till a few years ago confirms this as far as the general travelling public is concerned, but in addition they have always realised that gas had considerable potentialities in their workshops.

For many years before the nationalisation of the railways, the Great Western and the London, Midland and Scottish Companies had had their own gasworks at Swindon and Crewe respectively. The former was for the exclusive use of the locomotive works and is an example of forward thinking on the part of that Company, but being a private concern, it never became part of the gas industry.

With the improvement in service made possible by the reorganisation of the local gas supplies by the South Western Gas Board, the Western Region of British Railways could see quite clearly that it would be far cheaper for it to take supplies from the Board than to spend a lot of money on repairing and modernising its own works. At the same time it would get the full benefit of expert advice and the well-tested service of the Board's industrial engineers.

The paper by Mr. A. Riley which we are publishing this month is an account of some of the developments in the use of gas that have taken place in the Swindon locomotive works since his Board acquired that particular load in 1958; it now amounts to some 360 mill. cu.ft. per year.

This is a substantial load to one customer, but we feel that provided conditions there remain as they now are, it could be increased by converting more solid-fuel, and even some oil-fired, furnaces to gas.

The building of steam locomotives may well be a 'heavier' engineering process than the construction of diesels, and so with the passing of steam, there might well be a reduction in gas consumption, but an analysis of the processes for which gas is being used at the Swindon works and the possible extension of these uses, which we get from Mr. Riley's paper, makes us doubt this.

Clearly the boiler construction shop and the connecting rod forging shops are big consumers of gas, but a large scale production of diesels may well be embarked upon, besides there will be repairs and maintenance of steam locomotives for many years to come. The Swindon tradition, it seems to us, has always been to build its own locomotives even if it has meant using parts and components only standard throughout its own system, so it is unlikely that so drastic a change of policy as buying ready-made power units will appeal to the successors of so individual an undertaking as the Great Western.

The processes described by Mr. Riley are essentially those of heat treatment and are aids to fabrication equally applicable to similar construction in a number of industries, so whatever type of power unit will constitute the prime mover adopted by the railways of the future, the basic means of fabricating the components can still be done by gas, especially when this particular fuel has proved itself to be the handiest and therefore probably ultimately the cheapest available.

GAS —on the right lines

—WITH BRITISH RAILWAYS AT SWINDON

INDUSTRIAL activity has increased in Swindon progressively during the past four years and the town, which not very long ago had only one main industry, now boasts two industrial estates.

With the arrival of new industries there has also been an increase in the industrial gas load, but the most significant rise on the curve appeared in the early part of 1958 when the South Western Gas Board acquired the load at the British Railways works.

In a 12-month period up to quite recently the total consumption on the whole works was 360,000,000 cu.ft.

Swindon was a market town of some importance when the Great Western Railway came into being.

By December 1840 the railway had been extended from London to Bristol and the whole line, including the Box Tunnel, was in constant use.

With the rapid growth of the railway arose the necessity for the provision of a central repair depot for the maintenance of the rolling stock.

The project was a tremendous endeavour and included in addition to the repair depot a housing estate with community centres, theatre, hospital, swimming baths, churches and public houses.

Extending for a total of some 326 acres, the works are divided into three sections—locomotive, carriage and wagon. The present labour force is approximately 9,000 and the majority of them are employed in the workshops and offices with a roof area of some 78 acres.

The major part of the gas board's work has been carried out on the locomotive side, on the north side of the main line to Bristol and the West of England.

The mere individual with a little mechanical knowledge who decides to visit this large railway works and expects to leave, confident that he understands the complete manufacture of a locomotive, is likely to come away somewhat disillusioned.

Among the huge furnaces, forges, thumping steam hammers, whirring lathes and deafening riveting machines in the boiler shops and other departments a casual visitor is lucky to escape with only a mild headache and may even consider himself fortunate to carry away with him an intelligent perception of the working of some of the interesting machinery.

So it is with Swindon, the nursery and hospital of the British Railway Works, Western Region, so proudly referred to in pre-nationalisation days as 'The Great Western'.

As the visitor wends his way through the shops, one point at least impresses itself on the mind, that is the gigantic forces invisible and unsuspected almost under one's feet requiring the

From a paper presented to the Western Junior Gas Association by A. RILEY, Industrial Gas Engineer, Swindon District, South Western Gas Board.

mere touch of a lever or button to release tremendous power, either to transform a misshapen mass of metal into a symmetrically shaped billet, or to thump the same billet into a perfectly formed drawbar hook.

Some three years ago, the British Transport Commission was faced with heavy capital expenditure for repairs and reconditioning of their own gas manufacturing plant and, in view of this, consideration was given to the possibility of taking a supply direct from the South Western Gas Board's Swindon works at Gorse Hill.

It was finally agreed that the gas board could offer an immediate supply of 5 mill. cu.ft. a week, commencing in May 1958, and this quantity could be increased to 11 mill. cu.ft. in May 1959, subject to certain alterations being made to the board's plant to meet the increased demand.

It was decided to adopt a scheme to provide an independent supply main direct. This involved the laying of 2,500 yards of cast main and the project commenced on January 12, 1958, with a view to completion by the second week of the following March. The main was finally completed and tested and supply commenced on April 8, 1958.

The locomotive works retained certain personnel for their own internal use, but as the industrial engineer responsible for any advice required, I found it of considerable advantage to acquaint myself with the layout of feeder mains within the works.

One would consider the rolling mills to be the very heart of the locomotive works since, as an accommodation mill, there is a constant demand on it for a wide variety of special sections in iron and steel, very often at short notice for use both in the Swindon works and outside departments.

The advantages from the existence of the rolling mill are many. Stocks of materials within the capacity of the mill can be kept at lower level than would otherwise be possible, special railway sections and normal sections to B.T.C. specifications can be rolled if necessary in small quantities, and at short notice, which would be unobtainable from the trade, thus covering emergency requirements resulting from changes in new work, building programmes and delay in deliveries from the trade.

The furnace equipment at the present time comprises two Buschelling furnaces for iron, two billet heating furnaces, which are all coal fired, and a large Priest billet heating furnace, alternatively gas or oil fired. The latter is a comparatively recent addition and forms the centre piece.

Recently extensive performance tests have been carried out on the solid fuel furnaces with a view to conversion to gas or oil firing.

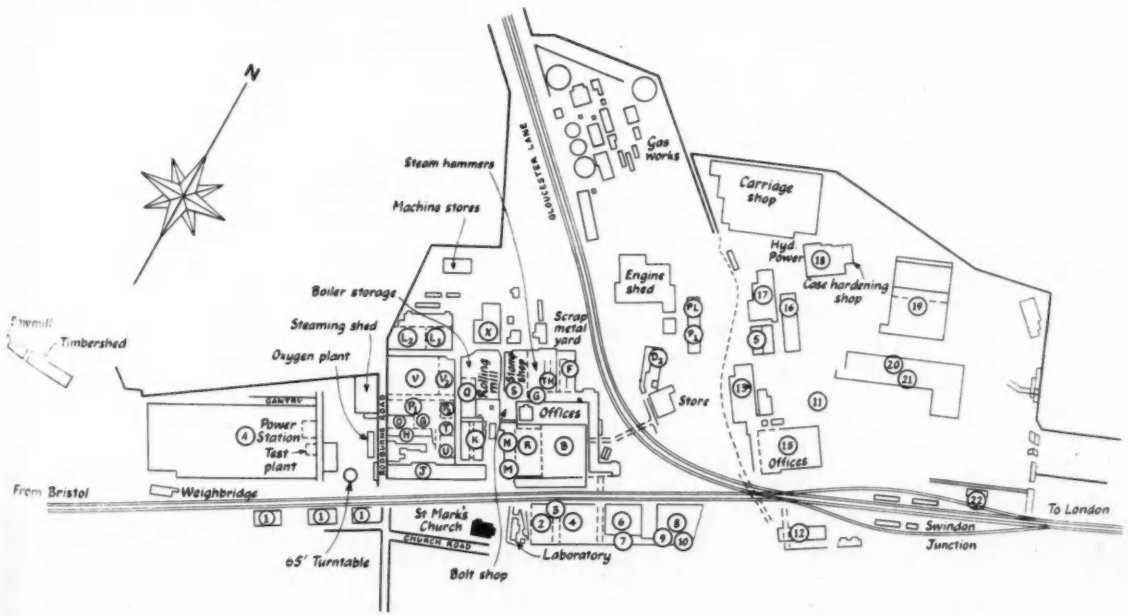
Valuable information was obtained from these exercises and if the recommendations put forward are adopted there can be no doubt of the ultimate improvement in both the finished product and conditions within the department.

The Priest furnace is a standard continuous type, being end charged and end discharged. The stock is pro-

SITE PLAN

LOCOMOTIVE WORKS: A, Erectors, boilermakers and machine shops. B, Erectors, painters and tender shop. D_1, Carpenters. D_2, Mason's yard. F, F_2, Electrical shop. G, Smiths, springsmiths and chainmakers. H, Millwrights. J, Iron foundry. K, Coppersmiths and sheetmetal workers. L_1, Tube heaters. L_2, Tank shop. N, Power House. M, Grinders. O, Machine shop. P_1, Boiler mounting. P_2, Turners and machinemen. PL, Loco. works roads maintenance. Q, Angle iron smiths. R, Fitters, turners, and machinemen. S, Bolt makers and stamping. T, Brass finishers. TH, Testing house. U, Brass foundry. V, Boilermakers. V_2, Turners and machinemen. X, Points and crossings.

CARRIAGE AND WAGON WORKS: 1, Timber yard. 2, Saw mill. 3, Fitting and machine shop. 4, Coach body building. 5, Electric lighting equipment stores. 6, Carriage repairs. 7, Carriage finishing. 8, Carriage painting. 9, Carriage trimming. 10, Laundry polishers and sewers. 11, Power station. 12, Carpets and polishers. 13, Frame building. 14, Smiths. 15, Fitting and machine shop. 16, Wheel shop. 17, Road vehicle building and repairs. 18, Stamping. 19, Carriage lifting and repairs. 20, Horse box repairs. 21, Wagon building and repairs. 22, Grease work. 23, Carriage and wagon roads maintenance.



gressed through the furnace by means of an electrically-operated, twin-screw pusher, directly on to the mill roller table.

The furnace has an effective length of 22 ft. and a width between the side walls of 9 ft.

Billets of up to 7 ft. long and 3 ft. 6 in. square can be accommodated, although on many occasions the furnace chamber is charged with double rows of smaller billets.

BURNERS

Four Schieldrop gas/oil burners are arranged in the discharge end wall firing back along the length of the furnace, with a further pair in each side wall, one of which fires across the water cooled discharge ramp, the other being sited approximately half way along the furnace.

The burners, suitable for firing with gas or heavy fuel oil, are self-proportioning on both fuels so obviating the necessity of automatic air/fuel ratio equipment.

The four main burners are controlled by automatic equipment, the remainder on hand control.

The control instruments are by Electroflo and comprise temperature regulation equipment for the four end burners and furnace pressure. Temperature is recorded from three points along the furnace.

The furnace has a capacity of four tons per hour and discharges via the 40-ft. roller table directly to the operator at the mill.

No recuperation is used for either gas or oil and when one considers the saving which could be effected on a high temperature furnace consuming 20,000 cu.ft. an hour on maximum load, the additional cost of a recuperator system would, I feel, be amply justified.

MONOPOLY ENDS

Until the latter part of 1959 the nut and bolt forging furnaces in the bolt shop were exclusively oil-fired. This monopoly was eventually ended by the management's decision to accept a gas-fired furnace, the result of a design by the South Western Gas Board's Area Industrial Engineer and his staff.

During a visit coinciding with the introduction of a new nut forging machine, suggestions were made as to the possibility of using gas in the bar heating process.

An initial test on the existing oil-fired equipment was carried out and the resultant figures analysed.

It was calculated that with recuperation gas could be employed more efficiently and equally as economically as oil, and with the accent on recuperation a drawing was submitted. A detail is shown in Fig. 1, together with the performance figures.

In the production of nuts from wrought iron the main consideration is temperature of the order of 1,400°C. with a consequent slag formation.

In the initial stages considerable erosion of the chamber was experienced but, by suitable modifications to the well of the furnace, and complete protection of the brickwork by moulded refractory, the difficulty was overcome and the need for frequent repair eliminated.

The main feature lies in the method of recuperation and full benefit has been obtained from the waste gases emitted from the main chamber.

One of the most essential requirements in modern rail transport is the suspension, and to provide the components for this vital part of the vehicle, a department was opened for the production of all types of springs.

REGENERATORS

The use of flue gases to heat combustion air on all the spring furnaces has been fully exploited by the introduction of regenerators. The furnaces are all completely gas-fired and were constructed by the Davis Furnace Co.

The setting of the springs is carried out at 1000°C. while subsequent heat treatment includes hardening at 850°C. and tempering at 400°C.

Each chamber in the battery is provided with its own pair of regenerators built into the furnace structure beneath the floor of the heating chamber.

The regenerators ensure the maximum amount of heat in the products of combustion passing through to the flue outlets being recuperated and returned to the working chamber hearth in the form of highly preheated air.

INDEPENDENT

The regenerators are under separate control and if necessary the furnace can be operated as an entirely independent unit.

Built of massive chequer brickwork and divided by a partition wall, the regenerators form two distinct sections —one on the left-hand side and one on the right-hand side beneath the furnace chamber— each section being connected to its respective side of the heating chamber by ports which become alternatively combustion or exhaust ports according to which side of the chamber is being fired.

Each section of regenerator is con-

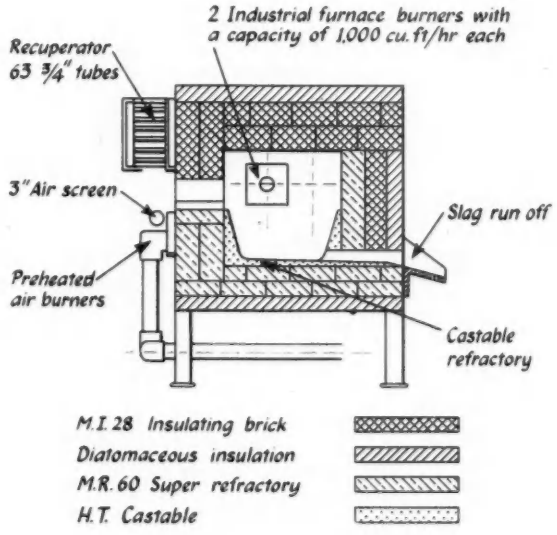


Fig. 1

Results of tests carried out on both the gas and oil-fired furnaces when identical materials were processed—Gas Furnace: Fuel consumed per cwt. excluding heating up period, 3.17 therms; fuel consumed per cwt. including heating up period, 4.3 therms. Oil-Fired Furnace: Fuel consumed per cwt. excluding heating up period. 5.3 therms; fuel consumed per cwt. including heating up period, 8.34 therms.

nected to its own system of gas and air inlets and exhausts but, at the same time, a three-way main control valve connects each system to the flue, this valve being operated by a common control lever and changeover gear.

Two coil spring furnaces also operate at a temperature of 1,000°C. and again are divided into two working chambers on each, with the independent gas and air controls and regenerator system.

Coil gear is assembled at the entrance to each heating chamber and as the stock reaches the required temperature the long bar is coiled direct from the furnace.

SPRING SHOP

During the last few months considerable re-organisation of the spring shop has been in progress.

A recent addition to the furnace equipment is a continuous tempering furnace, installed by Currans of Cardiff.

This furnace is working in conjunction with a German spring former and the whole process is a step towards further modernisation of the department.

Designed for operating at a continuous temperature of 500°C. the furnace dimensions are 25 ft. by 12 ft. by 10 ft. 6 in. high.

Heating equipment comprises two low pressure gas/air burners, each with a maximum consumption of 2,000 cu.ft. per hour, firing into a combustion chamber sited on top of the main structure and products pass into a recirculating stream before entering the main chamber.

RECIRCULATION

Recirculation is provided by two paddle centrifugal fans fitted with water cooled bearings, the hot gases being returned from the work chamber to mix with the products of combustion before passing once again to the work above and below the conveyor.

The plates are progressed through the furnace on a conveyor consisting of ¼-in. alloy steel slats with a reduction gear drive at the feed end.

Temperatures are automatically controlled and recorded by Electroflo equipment.

The control pyrometer operates in conjunction with a Selas combined gas and air valve and Satchwell motor, with a hand control by-pass valve for use as required.

The burner system is fully protected against flame failure by thermo-electric equipment and micro switches.

With the re-organisation of the spring shop the furnace is a valuable contribution and is capable of handling up to 1¼ tons of spring plates an hour.

To facilitate the building and repair of locomotives in the erecting shop, such parts as frames, angle irons, cylinders, etc. are prepared in the fitting shops and handed over practically completed for the erectors.

An interesting process is that of tyre fitting, which employs the Selas-type heating furnace, capable of handling any size of wheel.

The furnace consists of a shallow circular hole in the floor—in which the tyre is laid—and has a number of segmental gas/air burners which can be arranged around the periphery.

The number of burners varies with the size of tyre and heating time may occupy from 20-30 minutes.

On reaching the desired temperature the tyre is removed from the furnace and placed on a circular table. The pair of wheels for tyring is suspended with the particular wheel concerned at the bottom and lowered into the hot tyre.

LOCATING RING

A locating ring on the wheel fits into the side recess machined in the tyre.

On completion of the tyre operation on both wheels the assembly is then removed to a 7 ft. heavy duty wheel gauge lathe.

Rough turning is undertaken at a speed of 15 ft. a minute with a metal removal of 17 cu.in. a minute.

The final finish is carried out on the same lathe, using form tools corresponding to the complete profile of the tyre flange and tread.

The plant handles approximately 6,500 pairs of new and repaired wheels a year in sizes ranging from 2 ft. 6 in.-6 ft. diameter.

With the diesel locomotive programme gaining momentum it would seem that the necessity for large castings is now on the decline, although there will no doubt be a call for some work as the repair programme on existing steam engines continues.

The iron foundry is a large and exceptionally lofty building with ample window and natural roof lighting and one cannot help noticing the comparatively clean atmosphere compared with some other similar establishments.

The fuel used in core and mould drying is exclusively gas, as with ladle drying, and when one considers that the capacities of seven large brick built chambers are approximately 6,500 cu.ft. each, it will be appreciated that the iron foundry has one of the largest gas consumptions in the works.

These enormous ovens are of a conventional design with drilled bar burners projecting along each of the inside long walls for 18 ft. Ventilation is purely by natural convection the flue outlet being positioned at high level on the rear wall.

In addition to the large drying chambers considerable use is made of gas-fired core ovens in the light casting department.

FORGINGS

In addition to castings, a very large number of components used in locomotive and carriage construction commence as forgings or stampings and indeed, typical examples of some of these components are the connecting rods produced in lengths of up to approximately 11 ft.

The 'blooms' for these huge forgings vary in length up to 8 ft. and may be 16 in. by 7 in. in sections.

The activities of the operatives handling these 'blooms' is a delight to see and like the rolling mill, workers are obviously highly skilled in their job.

A recent addition to the stamping shop is a large furnace for 'bloom' heating. This equipment has been installed some considerable time, but for a number of years has been idle due to its inefficiency for the particular application.

The furnace had a floor area of 64 sq.ft. which was considered too large even for the largest billet. Recommendations were put forward to modify the chamber and burner equipment.

TWO CHAMBERS

These were accepted and the furnace now comprises two chambers, each fired by a nozzle mixing burner. The chambers are alternatively heating or pre-heating and are connected by an opening in the centre dividing wall.

Four flues convey the products of combustion to atmosphere via recuperation of the multi-tube type and the preheated air is delivered to the burners by the fan producing a pressure of 14 in. w.g. at 500°F.

The boiler shop is the birthplace of all new boilers used on the Western Region. In addition the bulk of the repairs are carried out here also.

The main gas consumption is for

heating large copper and steel plates used in the construction of the boilers and to accommodate them two furnaces are used, the largest having a floor area of 176 sq.ft.

Before the flanging operation, the copper plates are heated in the furnace to a temperature of 800°C, and steel to 1,000/1,100°C. A travelling platform connects the furnace to the press which commences at 800 p.s.i. and is intensified to 1,500 p.s.i. towards the end of the operation.

The furnace is not confined to this work, but is also used for other requirements, including the stress relieving of other large fabricated sections.

CASE HARDENING

The case hardening shop has also been the subject of a costly reorganisation programme during recent months and with the introduction of furnace controls, governor equipment, and rebuilding, an estimation of the saving in fuel costs effected is £3,500 a year.

Five horizontal and one vertical furnaces handle most of the heat treatment of special steel components and, with the modern handling and quenching plant, the department is a highly efficient part of the organisation.

The vertical furnace is probably the most interesting and was originally installed for the heat treatment of gun barrels during the 1914-18 war. Rising to a height of 16 ft. the furnace is virtually three separate chambers each having its own 3-in. diameter spiral muffle.

Each section of the furnace is is heated by three gas/air blast burners with a total gas consumption of 2,500 cu.ft. an hour.

THERMOCOUPLES

Individual control of each section is obtained by thermocouples, the latter being linked to separate recorders, while overall flame failure is provided by a Flame-otrol electronic device of the electrode type, situated in the centre section.

A constant temperature of 850°C. is maintained within ±5°C. and it is significant to note that since the overhaul of the furnace and introduction of the controls five years ago there has not been a single reject.

The furnace is now used exclusively for connecting rods, bar work and coupling rods, manufactured from high grade steels.

The remainder of the furnaces are used for case hardening, stress relieving and various other process work on tool steels and are straightforward batch type units 14 ft. by 11 ft. 6 in. long.

Some indication of the amount of work processed in the shop can be obtained from the gas consumption of 50,000,000 cu.ft a year.

In addition to the gas consumed on what is considered main process work, there are many smaller assemblies contributing towards this valuable load.

Some months ago we were requested by the management to provide an alternative heating arrangement to the existing coke-fired hearth used in the rail bending process.

High temperatures for this particular work are not necessary and in fact are as low as 200°C. Complicated furnace equipment was not required and as a contribution towards economy it was decided to convert the existing hearths.

The well of the hearth was built up with firebrick and two gas supplies complete with Hypact 400 burners placed opposing each other, 6 in. from the hearth level with sufficient distance between them to accommodate the rails.

The main gas control was by-passed and a short flame maintained at the burner heads when on standby.

CLEANER

On requiring treatment for a rail the main gas control was opened until the desired temperature obtained.

This conversion has proved very satisfactory for in addition to achieveing the main object of improving the atmosphere in the shop, the process is cleaner, quicker and with the convenience of a single main gas control, costs can be maintained at their present level.

The practice of tea breaks is of course also recognised throughout the locomotive works and in order that personnel can make their own tea in the shops, hot water urns are placed at vantage points.

The urns are heated by gas and lit to ensure water is available at the right time. Quite often however, the urns reached boiling point with a consequent waste in fuel and time by the men responsible for filling them.

Thermostatic control was suggested for each urn and since the maximum temperature is set at 210°F. there is no waste in water or fuel. (Contrary to belief, tea will fuse in water perfectly satisfactorily at any temperature between 209° and 212°F.)

Steam for space heating is used extensively throughout the works, but there are many instances where the steam supply is either not convenient or too costly to lay on for certain buildings and there have been several cases where gas-fired unit heaters have proved to be the answer.

With the coming of the Clean Air Bill and factory regulations on the use of open hearths, the Gas Board has been consulted to provide alternative gas-fired equipment.

A more recent example of this was the rivet-heating furnace in the boiler shop.

BY WORKS STAFF

Drawings were prepared and again the complete assembly of two small furnaces was carried out by the works own staff. The only component the Gas Board were called upon to supply was a non-return valve for each furnace.

During the three years we have been closely associated with the management, extensive reorganisation has been in progress the main objective being modernisation. Many of the projects involve the use of our fuel.

The lighter work on diesel locomotion will no doubt affect the gas load especially in departments like the iron foundry, heat treatment and boiler shops, but with the excellent facilities in factory accommodation existing at the Swindon works, maybe we shall see in the future production lines for the manufacture of diesel engine components, in which case gas must surely play an important role.

The British Railways system is still the finest in the world and, in Swindon. they have the repair organisation complimentary to it.

Chicken singeing

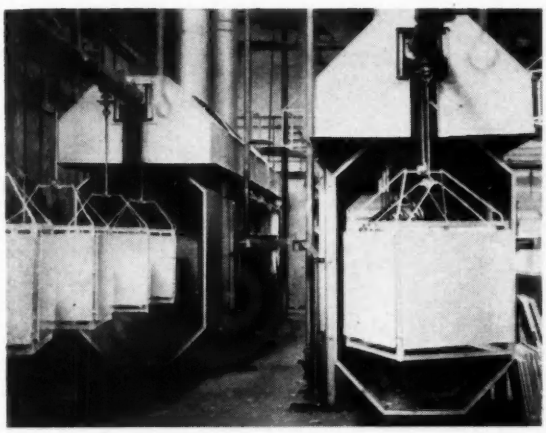
CHICKEN singeing while the birds were being transported was the subject of a recent study. The object was to singe 300 chickens per hour, each bird being covered with a film of moisture, by a method other than a manually operated gas torch.

The appliance used consisted of four U.11 Duoflam burners mounted in pairs one above the other. Four jets were removed from the top of each pair of burners in order to provide a flame length of approximately 24 in. on each side.—*From Report No.* 701/59 *of the Industrial Gas Development Committee* (*Supplied by the West Midlands Gas Board*).

More gas-fired equipment for stoving

UNDERLINING the present trend for manufacturers to use gas-fired radiant heat stoving equipment is the installation recently completed by Parkinson Cowan Industrial Products at AEI-Hotpoint, Peterborough.

Until two years ago, the stoving of washing machines and refrigerators in the Peterborough plant was handled by two electric ovens. Demand for AEI-Hotpoint appliances increased and to cater for the stepped-up production, Parkinson Cowan Industrial Products installed two 15-ft. gas-fired radiant heat ovens.



Two 15-ft. gas-fired radiant heat ovens finishing washing machine doors in the Peterborough factory of AEI-Hotpoint Ltd. All the finishing ovens in this factory were supplied and installed by Parkinson Cowan Industrial Products.

With the introduction of the 'Iced Diamond' refrigerator AEI-Hotpoint again stepped up their production at Peterborough and extended the factory premises. Two further Parkinson Cowan Industrial Products ovens were installed with conveyors, water wash spray booths and electrostatic sprays.

The two ovens involved in this second installation were a primer coat stoving oven, 72 ft. long consisting of 144 panel units operating at 600°F., and a finishing coat stoving oven, 66 ft. long consisting of 132 panel units operating at 450°F.

As a result of experience gained from the operation of the first two gas-fired radiant heat equipments, AEI-Hotpoint recently decided to install yet another gas-fired infra-red oven.

Parkinson Cowan Industrial Products again designed the plant in co-operation with AEI-Hotpoint and manufactured the ovens.

Installation work on the new ovens, both 27 ft. long and consisting of 54 panel units, was performed during a holiday period.

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Car component makers find—

GAS is ideal for heat treatment

★

EVERY motor manufacturer relies on a number of outside engineering firms for some of the most important components entering into the construction of the passenger and commercial vehicle. Among the many parts which are bought in by motor manufacturers in this way is that vital component, the propeller shaft, the pre-eminent manufacturer of which is the well-known firm of Hardy Spicer Ltd., Erdington, Birmingham (a Birfield Group Company).

This Company, which has been engaged in the manufacture of propeller shafts, universal joints and flexible couplings for the motor and other trades since 1914, produces no fewer than 95% of all the shafts supplied to the British passenger and commercial vehicle industry.

In addition, the firm supplies shafts, joints and couplings to manufacturers of locomotives, rail cars, helicopters, cranes, fork lift trucks and to others in the general engineering and industrial fields.

Parts which are of such obvious importance to the efficient and safe running of the motor vehicle must necessarily be given the most effective heat treatment and gas has been selected as the fuel for this purpose.

It offers the easy, yet positive, control necessitated by the standards demanded by Hardy Spicer metallurgical and engineering departments.

Total gas consumption for heat treatment and incidental processing at the factory amounts to approximately 300 mill. cu.ft. a year, supplied by the West Midlands Gas Board.

All necessary types of heat treatment is in use at the works, ranging from huge continuous gas carburising plant to small batch-type general heat treatment furnaces.

This variety of equipment is required to deal with the many different components needing heat treatment. These range from tiny needle rollers, weighing as little as ½ gramme, to forgings up to 56 lbs., which go to make up the completed universal joint or propeller shaft.

It is perhaps not always realised that the conventional motor car propeller

shaft is made up of no fewer than a score of separate parts, of many differing materials, all of which must be manufactured to within very fine limits and given the appropriate form of heat treatment at various stages of manufacture and finishing.

At Hardy Spicer Ltd., the heat treatment equipment is laid out in two main departments, serving the Hardy Spicer Propeller Shaft Division and the Birfield Joint Division respectively.

WHO'S WHO

The Hardy Spicer Heat Treatment Department is concerned with the treatment of all the components of this type of propeller shaft and component parts, while the Birfield Joint Division deals with the heat treatment of the components of the celebrated Birfield joint, which is mainly incorporated in forward-wheel-drive vehicles, such as the Morris Mini-Minor, Austin Seven and Lancia Flavia.

Both departments are exceptionally well-laid-out, with plenty of room for the service of the equipment and for the movement of work into and out of the furnaces. The buildings are well-lit and airy.

In the department devoted to the heat treatment of Hardy Spicer components, the great variety of equipment, all of which has been supplied and, in the main, maintained by Fuel Furnaces Ltd., Shady Lane, Great Barr, includes rotary carburisers, semi-continuous re-heating furnaces, pit-type furnaces for sub-critical annealing treatments and traditional batch and continuous hardening, tempering furnaces, salt bath and continuous and batch type stress relieving equipment.

One imposing section is a double row of 22 sealed rotary retort type carburising furnaces, arranged 11 in each row, facing each other. Bearing cups and journal crosses are carburised in these furnaces.

Carburising atmosphere is obtained from the dissociation of a hydrocarbon and ammonia at suitable temperatures and pressure, and the component parts are direct quenched from these furnaces after carburising and diffusion standards have been satisfied.

Burner arrangement on each furnace consists of four natural-draft burners, firing on each side of the retort, the burners on each side being off-set with respect to one another.

By
ERIC FORD,
in collaboration
with
J. J. T. Nicholls, A.I.M.,
Chief Metallurgist,
Hardy Spicer Ltd.

PRE-HEATING

A pre-heating period is necessary to bring the temperature of the components to the required carburising temperature of 920°C.—930°C. at which temperature carburising continues for two to four and a half hours, depending upon the component and the depth of the case required.

Test samples are taken at intervals and checked for case depth by breaking and visual examination, a final assessment being made by grinding and etching.

At the completion of carburising,

A general view of the double bank of 22 sealed rotary retort-type furnaces in the heat treatment department of the Hardy Spicer Ltd. Propeller Shaft Division. Gas is used for the heat treatment of the firm's well-known shafts, which are fitted to 95% of British commercial vehicles. Note the carburising medium burning at the front of the furnaces.

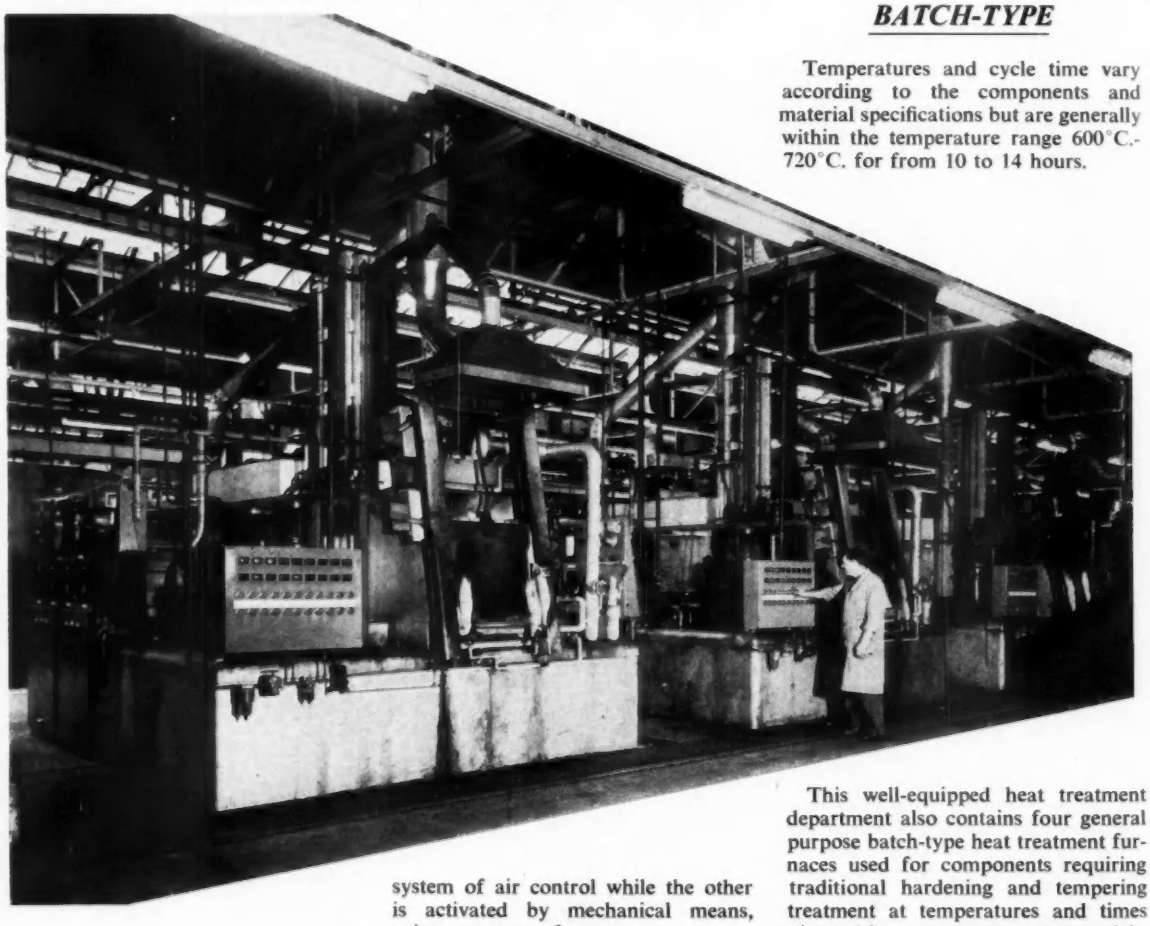
the burners are controlled to permit a fall to 860°C. for the diffusion period.

The components are then direct quenched in a quench tank situated at the discharge end of the retort.

Some of the most interesting equipment in this section is the tipping pan furnaces which are used for the case refinement treatment of components.

These furnaces consist essentially of nine metal pans which turn about their centres and slide their contents forward into the pan in front.

Some of the British Furnaces sealed quench furnaces in the Hardy Spicer Birfield Joint Department. The excellent layout of equipment and the exceptionally light and airy surroundings are typical of the heat treatment arrangements at Hardy Spicer Ltd.



Items for treatment arrive at the charging point of the furnace on a conveyor belt, to be introduced into an automatic weigher, pre-set to weigh the required amount of material for a single pan.

Controlled by a timing device, the components are tipped forward at the appropriate intervals. In sequence, from the charging end, the contents of each pan are deposited into the pan in front, thus leaving empty the pan nearest to the entry point of the furnace.

The contents of the pan at the discharge end are directed into a suitable quenchant, down a sealed chute, and are conveyed from this quench tank by an automatic conveyor.

The contents of the automatic weigher are then introduced into the empty pan at the charging end and the process cycle repeated.

By this means, the furnace is in continuous operation and the components each receive the same length of time in the furnace.

Two types of motivation are employed on these furnaces. One uses a system of air control while the other is activated by mechanical means, using a system of cams.

These furnaces are heated by natural draught burners, varying in number from four to eight a side, according to the size and type of furnaces. Operating temperatures range between 760°C. and 820°C., according to component and material specifications.

Among the other equipment in this department is a low temperature stress relieving furnace, for use at temperatures of the order of 200°C.

All carburised components are passed through this furnace. The work is placed on a continuous slotted hearth, and the burners are directed tangentially above the hearth and work.

Elsewhere in the department, the pit-type furnace is used for sub-critical annealing.

It consists of three separate chambers, in line, respectively providing pre-heat, soak and controlled cooling.

The burners for the soaking zone are forced draught, the pre-heat chamber being heated with waste gases from these.

BATCH-TYPE

Temperatures and cycle time vary according to the components and material specifications but are generally within the temperature range 600°C.-720°C. for from 10 to 14 hours.

This well-equipped heat treatment department also contains four general purpose batch-type heat treatment furnaces used for components requiring traditional hardening and tempering treatment at temperatures and times dictated by components and materials.

A general feature of the whole department is the quality and amount of instrumentation and the care which is taken to ensure that there is equipment available to meet any heat treatment requirements.

There is, for example, a gas-fired salt bath, fired by eight air blast burners. This is intended for the

selective tempering of components which require this treatment.

The components for treatment are correctly arranged in specially designed jigs which are then lowered into the salt to the required depth and remain immersed for varying periods of time.

They are then hoisted from the bath, drained of salt, moved away for a cooling period and later washed in water which is held at boiling point.

The movement of the jigs and loads is made possible by an overhead runway and crane. The bath has a temperature recorder/controller actuated by an immersion type thermocouple.

Equipment in the Birfield Joint Heat Treatment Department includes a large continuous gas carburiser (British Furnaces, Chesterfield) which is still undergoing final commissioning tests. This impressive furnace, which is 80 ft. in length, is a fully automatic two-track furnace, with a capacity of 44 trays of work on each track.

Components carburised in this furnace will require to be machined after carburising and before final heat treatment. The furnace therefore comprises a pre-heat zone, a carburising zone and a controlled cooling zone.

Process times and temperatures will depend upon the component, the material of which it is made and case requirements.

AUTOMATIC

Operation of the furnace is fully automatic, every stage being clearly indicated by signal lights on an unusually comprehensive and well-laid-out control panel.

The operator can therefore observe the indications of the various functions of the furnace as they take place in sequence.

Each of the two tracks pushes alternately but two trays enter the vestibule at the same time. It therefore follows that if the loading interval is, say, 40 minutes, one tray leaves the furnace from the cooling zone every 20 minutes.

Complete process time through the furnace is about 30 hours.

RADIANT TUBES

Radiant tube burners are sited along each side of the furnace, firing above and below the tracks. The basic furnace atmosphere is obtained from a central endothermic generator station, via a ring main, and is enriched with propane.

Also in the Birfield Joint Division are five sealed quench furnaces, manufactured by British Furnaces Ltd. and used for carburising, hardening and tempering.

A general view of part of the Hardy Spicer Ltd. Propeller Shaft Heat Treatment Department, showing, right, one of the tipping pan furnaces.

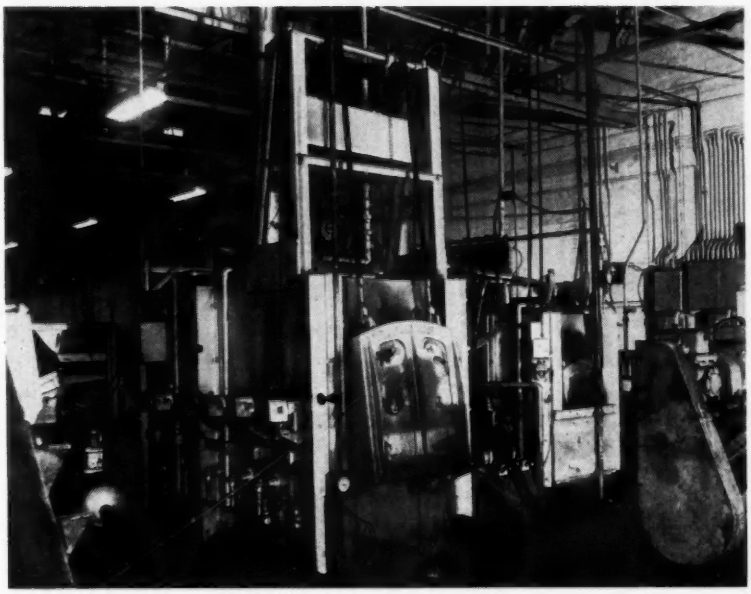
When employed on carburising, the atmosphere gas is obtained from the central endothermic generating station and is again enriched with propane. When used for traditional hardening and tempering, the atmosphere is obtained from an exothermic generator.

These five furnaces are fully automatic in operation but are manually loaded into and unloaded from the vestibule. Jigged up work is loaded on the lowerator in the vestibule and, when purging is completed, a programme is initiated.

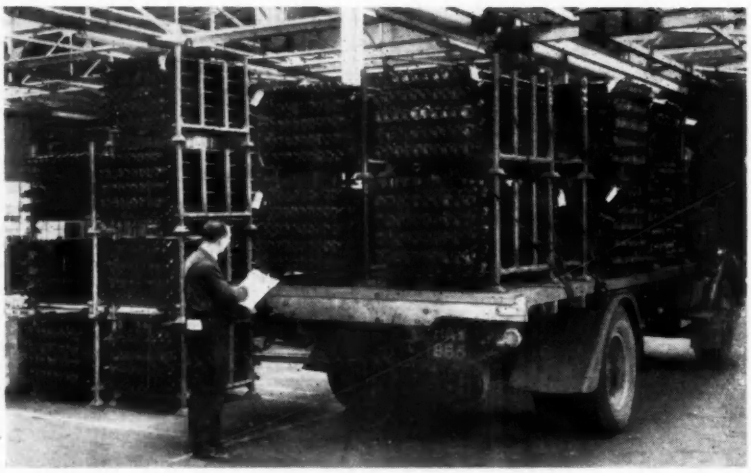
The inner furnace door is opened and the work pulled into the chamber by means of a rear mechanical handling unit.

At the end of the treatment cycle, the work is mechanically conveyed to the vestibule on the lowerator for oil quenching in the tank below the furnace.

Four radiant tube burners fire into the furnace from the rear, and a Honeywell Brown recorder/controller maintains the time and temperatures at the required levels demanded by the heat treatment cycle in force, which is controlled through a cam.



This illustration shows the discharge end of a tipping pan furnace. After treatment, the components are quenched in the tank below the furnace and automatically raised from the quench by the conveyor in the foreground.



A load of motor car propeller shafts ready to leave the Erdington works of Hardy Spicer Ltd., a member of the Birfield Group of Companies. Hardy Spicer, who supply about 95% of the propeller shafts used by the British motor car industry, also supply large numbers to overseas manufacturers. Gas is extensively used in the important heat treatment procedures employed.

A radiant tube burner also maintains the oil quench at the required temperature, employing a pilot burner to ignite the gas at the tube burner as required.

Two electrically-driven agitators are fitted to the quench tank.

This department is still in course of construction, and it is planned to incorporate into the heat treatment arrangements a rotary hearth furnace for the re-heating of components prior to quenching.

It will be possible to operate this furnace through a fairly wide temperature range.

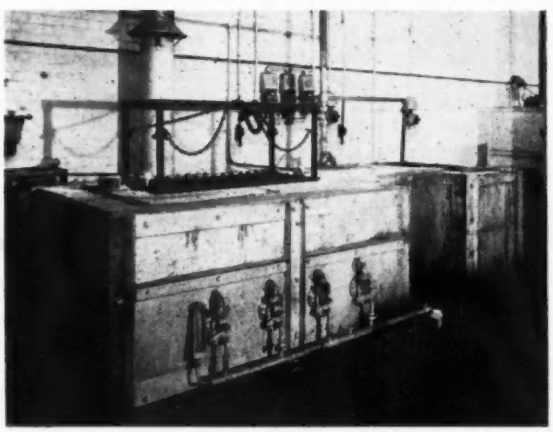
The furnace will be manually loaded and unloaded but will otherwise be fully automatic in operation.

Work from this furnace will be transferred to an oil quench and thence to an automatic washing machine. The final stage in this flow-process will comprise a stress relieving furnace of the air re-circulation type.

The combustion chamber will be on top with a fan to force the heated air down into the operating chamber below.

All this new equipment will be gas-fired.

Atmosphere carrier gas for the carburising furnaces in the Birfield Joint Division is produced at a central generating station, to which reference has already been made.



A gas-fired salt bath is used at Hardy Spicer Ltd. for the selective tempering of certain components. These can be seen undergoing treatment in the specially designed jig.

FOUR UNITS

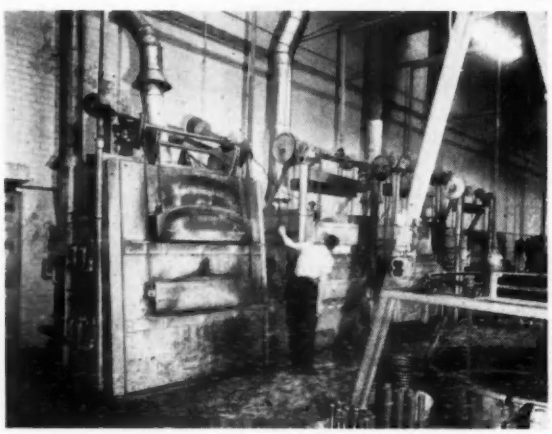
This station at present comprises four units, with more planned for installation in the near future.

Town gas provides the heating medium, the atmosphere being generated in the usual way by an air-propane mixture passing through a nickel catalyst.

Atmosphere carrier gas is distributed as required to the different furnaces by ring main and each furnace is then enriched with propane according to requirements.

The station has been well-designed and laid out with every attention to efficiency and ease of operation.

From this necessarily brief account of the heat treatment arrangements at the 21-acre site of Hardy Spicer Ltd., it will be clear that every care is taken to ensure that the best possible heat treatment techniques are applied to all the components despatched from this factory to their many customers in the United Kingdom and overseas.



A corner of the Hardy Spicer heat treatment department. The furnaces shown are batch type units employed on general heat treatment duties.

VITAL PART

Heat treatment, however, is only a part, though admittedly a vital one, in the process of manufacturing a propeller shaft or universal joint.

The raw materials which reach the Erdington site of Hardy Spicer Ltd. come by canal from Witton in the form of forgings.

They are fabricated and machined in the various departments of this modern factory, using up-to-date machinery and the most efficient flow-process techniques.

After heat treatment, many of the parts undergo other machining and finishing before entering the assembly departments.

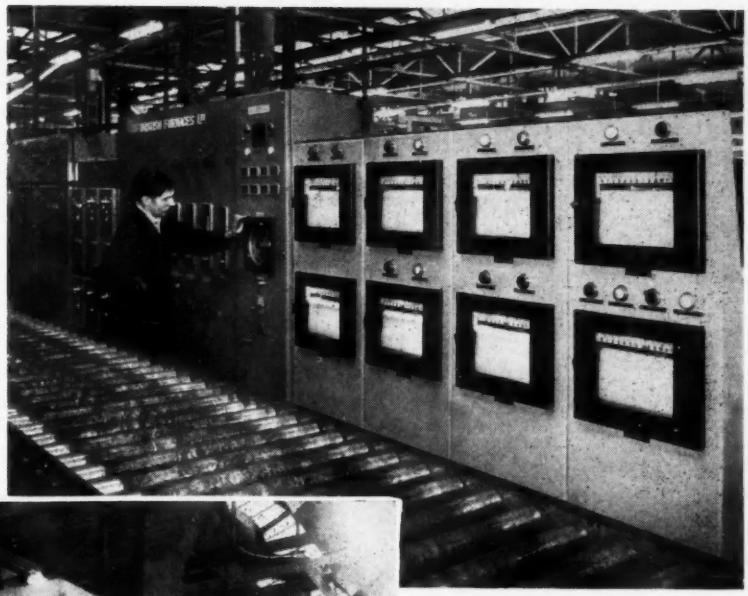
A great deal has therefore happened to the raw material before it goes through it final stringent testing schedule and is coated in anti-corrosive material in readiness for despatch.

It is the misfortune of the car propeller shaft that, despite the care which goes into its manufacture, it spends its life unseen except by those who are prepared to crawl under the vehicle.

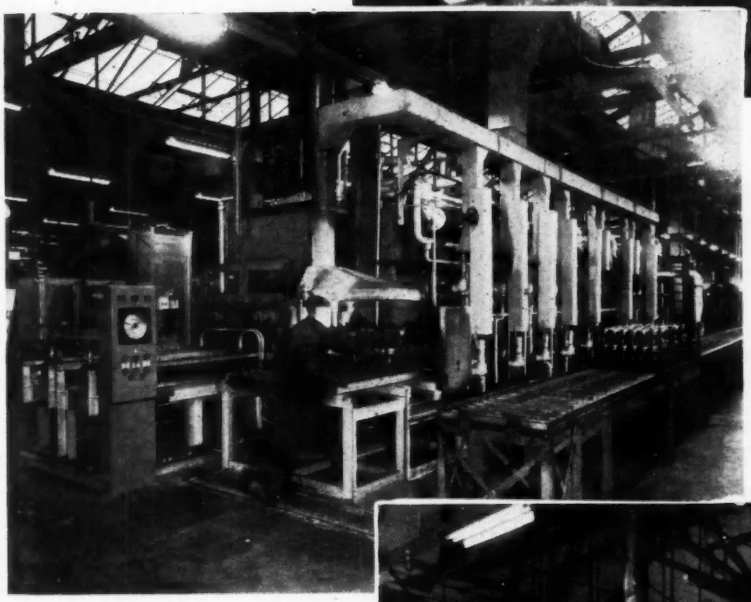
Most drivers are quite prepared to leave the shaft to perform its endless revolutions carrying the vehicle thousands of miles in all weathers. Many must have wondered at the efficiency with which this component performs its vital role.

If it is a Hardy Spicer product, and the overwhelming chances are that it will be, the careful heat treatment procedures controlled by a well-equipped and qualified Metallurgical Department, to which it has been subjected, are largely responsible for its long and trouble-free life.

Those who drive cars in which Hardy Spicer Ltd. components are fitted can also reflect upon the good use the Company makes of the fuel supplied to it by the West Midlands Gas Board.



One of the outstanding features of the heat treatment arrangements at Hardy Spicer Ltd. is the careful layout of controls. Illustrated here is the impressive control panel of the British Furnaces gas carburiser.



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A view of the entry end of the continuous gas carburiser in the Birfield Joint Heat Treatment Department at the Hardy Spicer plant. This gas-fired furnace, by British Furnaces Ltd., is 80 ft. long.

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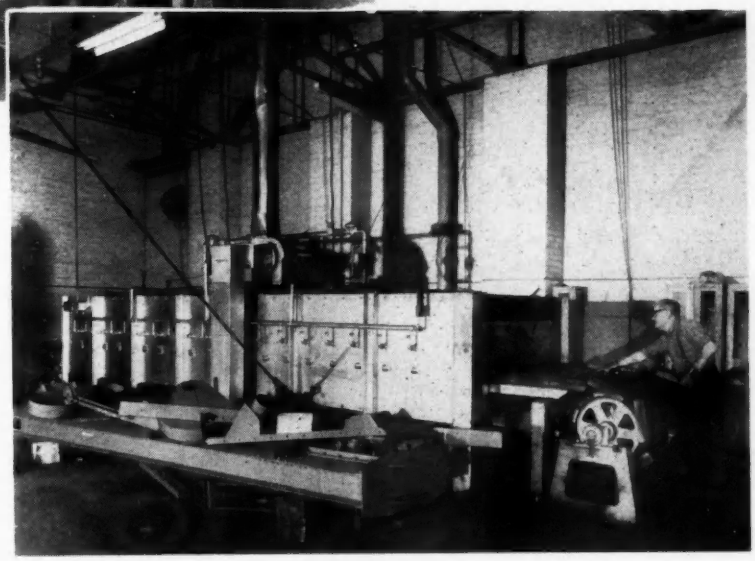

A low temperature stress relieving furnace through which all gas carburised components are passed.

LOOKING AROUND

Air heater

WORK has been carried out on the performance of a prototype direct fired air heater designed and manufactured by Heat and Air Systems Ltd., which was capable of an output of approximately 1.5 mill. B.t.u. per hour.

The heating section consisted of two concentric cylinders, the outer one being closed at one end by a plate, while the annulus between them was closed at the opposite end. The inner cylinder formed the combustion chamber in which a size 2500 Hypact burner, with ignition and flame failure probes, was situated.—*From Report No.* 721/60 *of the Industrial Gas Development Committee of the Gas Council* (*Supplied by the North Thames Gas Board*).

★

Small incinerators

THE present design of small gas-fired incinerators consists generally of a lined firebox, grate bars, gas burner and ash pit. Future designs may well include burner assemblies capable of smokeless incineration. The burner should be protected from blockage caused by falling ash, and the grate bars should be of the rocking or rakeable type to prevent accumulation of ash in the firebox.

The capacity of the ash pan should be sufficient to hold the ash produced in about seven days. Air for combustion can be taken either from the room in which the incinerators are installed or via a ducting from an outside source. In either case, the air velocity and direction must not adversely affect the performance of the appliance. Flues, operating under natural or mechanical draught are essential to the operation of the appliance.

An essential feature of an incinerator designed for individual use is the inclusion of a timing device to turn off the burner after a predetermined interval. This device usually takes the form of a dash pot mechanism which is set for operation by opening the charging door, and is fitted with means of adjustment which permits variation of the burner operating period. This period will vary with the type of installation, about five minutes for single appliances used infrequently, to ten minutes or more for heavier use. A flame protection device should ignite and provide means for safeguard of the burner—*From Report No.* 718/59 *of the Industrial Gas Development Committee of the Gas Council* (*Supplied by Watson House*).

★

Flame protection

THE Perlotronic type No. 90 electronic flame protection device, employs the principle of flame rectification for the detection of the pilot and subsequent control of the main gas.

Tests showed that there was a considerable reserve of power available to energise the valve under normal working conditions, and therefore under adverse conditions the valve should give satisfactory operation. Tests were carried out on the life of three pilot burner heads ; after 180 hours continuous burning, one had sufficient carbon deposit to bridge the electrodes and cause failure to cut-off.

These devices give instant shut-down in the event of flame failure and therefore may be used on appliances with higher gas rates than the maximum recommended for thermo-electric controls.—*From Report No.* 726/60 *of the Industrial Gas Development Committee of the Gas Council* (*Supplied by Watson House*).

★

Safety valve

THE Jeavons type J. 54 press-button weep low-pressure safety cut-off valve (industrial pattern), has recently undergone tests.

A cork washer forms the top seal of the press-button weep assembly and the diaphragm bonding rings are compressed simultaneously. The centre of the cover is tapped to receive a clamping screw which, together with a steel packing piece, holds the valve bob on its seating to avoid damage during transit.—*From Report No.* 726/60 *of the Industrial Gas Development Committee of the Gas Council* (*Supplied by Watson House*).

Pressure switch

THE Teddington pressure switch type KL/TIE/1 is designed to open or close an electrical circuit by means of static gas or air pressure or suction within the limits +10 in. w.g. and —10 in. w.g., with an operating differential of approximately 1 in. w.g. The electric rating of the switch is 5A at 230V.

The main components are a flexible diaphragm, a compound lever system, and a micro-switch designed to pass the rated current. The diaphragm is free to float in a shallow chamber formed by two flanged steel pressings, the lower of which has a hollow boss at its centre. The upper pressing carries the micro-switch, terminal block and pillars for locating and fixing the sheet steel cover which is finished in grey crackle enamel.—*From Report No.* 701/59 *of the Industrial Gas Development Committee of the Gas Council* (*Supplied by the West Midlands Gas Board*).

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Radiant heat unit

TESTS have been carried out on the Bratt Colbran high temperature heat processing unit to assess its suitability for industrial processes requiring high temperature radiant heat.

It was concluded that this type of heating unit may be successfully used in a high intensity radiant heating tunnel, and that using a tunnel of three sections each of four units, two facing each other 18 in. apart and two radiating downwards with their radiating surfaces at approximately 33° with the horizontal, will raise the temperature of a sheet metal object placed at the centre to 790°C., at an inlet gas pressure of 2.5 in. w.g., using Bray No. 266 2½ jets in the burners. Using a tunnel so constructed with a boosted inlet gas pressure of 7.8 in. w.g., the temperature of a sheet metal object can be raised to approximately 930°C. —*From Report No.* 704/59 *of the Industrial Gas Development Committee of the Gas Council* (*Supplied by the North Thames Gas Board*).